Science and engineering of biofilms: bioremediation and bioelectricity

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- Bioremediation

Biofilm technologies involved in natural and engineered biodegradation processes use surfaces to promote microbial adhesion and biofilm growth. A support was developed and tested both to control filamentous growth in wwtps and to upgrade conventional systems for nutrients removal [1]. A new biodegradable support that releases organic carbon at a controlled rate and supports biofilm growth is under development. This product will be applied in the bioremediation of groundwater contaminated with nitrate and secondary treated effluents that are severely limited in organic carbon.

- Bioelectricity

The microbial fuel cell (MFC) technology is based on the ability of some carbon oxidizing microorganisms to transfer electrons directly to an anode, thus generating electricity. Efficient electron transport between bacteria and electrodes uses biofilms due to the higher concentration of redox components in the vicinity of the electrode. Research efforts are currently directed towards the following MFC applications: i) biosensor for biochemical oxygen demand, ii) decentralized production of electricity, and iii) bioremediation strategy to control phosphorus release from lake sediments [2]. Selected topics which fall within the scope of the research team and where breakthroughs are needed in the short-medium term include: i) performance of different electrode materials, ii) electron transport mechanisms in biofilms, and iii) specific interactions between biofilm matrix and the electron-accepting electrode.

- Envisaged collaboration with other researchers

i) identification/characterization of biofilm components mediating electron transport

ii) characterisation of electron transport mechanisms using electrochemical techniques

[1] Nogueira R, Matos M, Alves C, and Brito AG, “Synthesis and degradation of poly-β-hydroxybutyrate in a sequencing batch biofilm reactor”, *Biores. Tech.* (2008) **100**: 2106-2110.

[2] Martins G, Peixoto L, Ribeiro DC, Parpot P, Brito AG, and Nogueira R, “Towards bentic microbial fuel cell implementation in volcanic eutrophic lakes: bacterial electrochemical activity assessment in Lake Furnas (Azores) - Portugal”, accepted for publication in *Bioelectrochem*.